

Appl. No. 09/360,292

REMARKS

Claims 15 and 35 are amended. Claims 15-24 and 35-41 are pending in the application.

Claims 15-24 and 35-41 stand rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains to make or use the invention. The Examiner states that the specification is not enabling for the recited step of removing a masking layer from a substrate. Applicant disagrees.

Applicant directs attention to the test of enablement set forth in the MPEP at § 2164.01. As indicated, the test of enablement is "whether one reasonably skilled in the art could make or use the invention from the disclosure in the patent coupled with information known in the art without undue experimentation" (quoting *United States vs. Telectronics, Inc.*, 857 F2d 778, 785, 8 USPQ2d 1217, 1223 (Fed. Cir.1988)). Additionally, as noted by the Court in *In re Buchner*, "a specification need not describe --and best omits-- that which is well known in the art." (929 F2d 660, 661, USPQ2d 1331, 1332 (Fed. Cir. 1991)). There are clearly methods of removing masking layers such as photoresist that are well known in the art. Indeed, photoresist removal (whether positive or negative) has been well known since the dawn of photolithography. Further, by way of example only, the specification discloses possible others as being silicon dioxide and silicon nitride. These are the two most ubiquitous insulators in semiconductor processing, and methods for chemically, mechanically and

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chemical-mechanically removing these materials from substrates are incredibly well known.

Applicant is not required to describe well known methods that can be used for purposes of the disclosed invention. The recited removing a masking layer (claims 15-24) and the recited removing a photoresist (claims 35-41) are sufficiently enabled to allow "any person skilled in the art . . . to make and use the same" without undue experimentation, as required by 35 U.S.C. § 112. Independent claims 15-24 and 35-41 are fully enabled by applicant's disclosure. Accordingly, applicant respectfully requests withdrawal of the § 112 rejection of claims 15-24 and 35-41 in the Examiner's next action.

Claims 35 and 39-41 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Zhao et al., U.S. Patent No. 6,204,192. As amended, independent claim 35 recites dry etching a first layer immediately beneath a photoresist through openings in the photoresist, the dry etching extending the openings to expose a substrate material comprising silicon at a base surface of the openings. The amendment to independent claim 35 is supported by the specification at, for example, page 6, lines 10-14; page 6, line 22 through page 7, line 1; and Fig. 3. Claim 35 further recites removing the photoresist subsequent the dry etching and plasma etching to remove carbon containing polymer residue before depositing any material over the substrate. Zhao discloses forming openings to ~~+~~ expose a copper material and cleaning the surfaces at the bottom of the opening to remove oxides and etch residues from the copper interconnect surface (col 4, ln 65 through col 5, ln 22 and col 3, lns 53-61). Zhao does not teach or

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suggest the recited extending openings to expose a silicon material at a base of the openings and plasma etching carbon containing polymer residue from the substrate. Independent claim 35 is therefore not anticipated by Zhao and is allowable over this reference.

Dependent claims 39-41 are allowable over Zhao for at least the reason that they depend from allowable base claim 35.

Claims 15-20, 22-24, 35-36 and 38-41 are rejected under 35 U.S.C. § 102(e) as being anticipated by Smith, U.S. Patent No. 6,277,733. As amended, independent claim 15 recites first etching a material beneath a masking layer through openings in the masking layer to outwardly expose a material comprising silicon at the base of the openings. Claim 15 further recites removing the masking layer after the first etching and before depositing any material over the substrate, plasma etching the substrate at a temperature of at least 400° C. The amendment to independent claim 15 is supported by the specification at, for example, page 6, lines 10-14; page 6, line 21 through page 7, line 1; and Fig. 3. Smith discloses formation of an opening to expose a metal layer, removal of photoresists and utilizing a plasma to remove hydrocarbon residue left on the metal surface (col 3, ln 63 through col 4, ln 43). Smith does not teach or suggest the claim 15 recited extending an opening to outwardly expose a material comprising silicon at a base of the opening and plasma etching the substrate prior to depositing any material over the substrate. Claim 15 is therefore not anticipated by Smith and is allowable over this reference.

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Dependent claims 16-20 and 22-24 are allowable over Smith for at least the reason that they depend from allowable base claim 15.

As discussed above, independent claim 35, as amended, recites extending openings to expose a silicon comprising material at a base surface of the openings and plasma etching a carbon containing polymer residue prior to depositing any material over the substrate. Independent claim 35 is allowable over Smith for at least reasons similar to those discussed above with respect to independent claim 15.

Dependent claims 34-36 and 38-41 are allowable over Smith for at least the reason that they depend from allowable base claim 35.

Claims 21 and 37 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Smith and further in view of Taguwa, U.S. Patent No. 6,020,254. As discussed above, independent claim 15 is not anticipated by Smith. Furthermore, the Smith disclosure does not suggest the recited etching a material beneath a masking layer which extends openings to outwardly expose a silicon material at a base of the openings and, after removing the masking layer, plasma etching the substrate. Independent claim 15 is therefore not rendered obvious by Smith.

Taguwa discloses forming a contact hole utilizing lithography and dry etching (col 5, Ins 30-33), and after forming the contact hole, forming an oxide film utilizing an oxygen plasma (col 5, Ins 36-39) and etching the oxide film utilizing a plasma of argon and hydrogen gas (col 5, Ins 47-53). Taguwa does not disclose or suggest the claim 15 recited extending an opening to expose a

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silicon comprising material at a base of the opening and, prior to any subsequent deposition of material over the substrate, plasma etching the substrate. As combined, Smith and Taguwa fail to teach or suggest the claim 15 recited extending an opening to outwardly expose a silicon comprising material and prior to any subsequent deposition of material over the substrate, plasma etching the substrate. Independent claim 15 is therefore not rendered obvious by Smith in view of Taguwa and is allowable over this combination of references. Dependent claim 21 is allowable over the combination of Smith and Taguwa for at least the reason that it depends from allowable base claim 15.

As discussed above, independent claim 35 as amended recites extending openings to expose a material comprising silicon at a base surface of the openings and before subsequently depositing any material over the substrate, plasma etching a carbon containing polymer residue from the substrate. Independent claim 35 is allowable over the combination of Smith and Taguwa for at least reasons similar to those discussed above with respect to independent claim 15. Dependent claim 37 is allowable over the combination of Smith and Taguwa for at least the reason that it depends from allowable base claim 35.

→ Claims 15-16, 21-22 and 35-38 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Donohoe et al., U.S. Patent No. 6,093,655, in view of Egashira, U.S. Patent No. 5,902,134. Donohoe discloses formation of a polymer material over sidewalls and at a base of a contact opening during etching to form the contact hole (col 3, ln 62 through col 4, ln 9), depositing a second polymer material within the contact opening (col 4, lns 24-47) and

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subsequently removing photoresist (col 5, Ins 5-8 and Fig. 6). Donohoe does not teach or suggest the claim 15 and claim 35 recited extending of openings to expose a silicon comprising material, after extending the openings, removing a photoresist layer and, after removing the photoresist layer and before depositing any material over the substrate, plasma etching the substrate.

Egashira discloses production of a fluorocarbon film as a result of dry etching and removing the fluorocarbon film by ashing with oxygen gas either with simultaneous removal of a photoresist (embodiments 1 and 4) or with subsequent removal of the photoresist (embodiments 2 and 3). Egashira does not disclose or suggest the claim 15 and claim 35 recited extending openings to expose a silicon material at a base surface of the openings, after extending the openings removing a photoresist layer from the substrate and, after removing the photoresist layer, plasma etching before subsequently depositing any material over the substrate. As combined, Donohoe and Egashira fail to disclose or suggest the claim 15 and claim 35 recited features of extending openings to expose a silicon comprising material at a base surface of the openings, after extending the openings removing a photoresist layer from the substrate and after removing the photoresist layer, plasma etching before subsequently depositing any material over the substrate. Independent claims 15 and 35 are therefore not rendered obvious by Donohoe in view of Egashira and are allowable over this combination of references.

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Dependent claims 16, 21-22 and 36-38 are allowable over the combination of Donohoe and Egashira for at least the reason that they depend from corresponding allowable base claims 15 and 35.

For the reasons discussed above, claims 15-24 and 35-41 are allowable. Accordingly, applicant respectfully requests formal allowance of claims 15-24 and 35-41 in the Examiner's next action.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE ACCOMPANYING
RESPONSE TO JANUARY 30, 2002 OFFICE ACTION

In the Claims

The claims have been amended as follows. Underlines indicate insertions
and ~~strikeouts~~ indicate deletions.

15. (Amended) A plasma etching process comprising:
forming a masking layer over a substrate;
patterning the masking layer to form openings therein;
first etching material beneath the masking layer through the openings, the
first etching extending the openings to outwardly expose a material comprising
silicon at a base of the openings;
after the first etching, removing the masking layer from the substrate; and
after the removing and before subsequently depositing any material over
the substrate, plasma etching the substrate at a temperature of at least 400°C.

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35. (Amended) A plasma etching process comprising:

forming a photoresist layer over a semiconductor substrate;

patterning the photoresist layer to form openings therethrough;

dry etching a first layer immediately beneath the photoresist layer through the openings, the dry etching extending the openings to expose a substrate material comprising silicon at a base surface of the openings and forming a carbon containing polymer residue at least partially over the substrate material at the base of the openings during the first dry etching;

after the dry etching, removing the photoresist layer from the substrate;

and

after the removing and before subsequently depositing any material over the substrate, plasma etching the carbon containing polymer residue from the substrate substantially selectively relative to the first layer.

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